



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Shunpei YAMAZAKI et al.      Art Unit : Unknown  
Serial No. : 09/783,426      Examiner : Unknown  
Filed : February 15, 2001  
Title : EL INDICATOR (DISPLAY DEVICE) AND ELECTRONIC DEVICE

Commissioner for Patents  
Washington, D.C. 20231

PRELIMINARY AMENDMENT

In the specification:

Please cancel the text on page 1, lines 1-4.

Please move the claims extending between page 1, line 5, and page 3, line 10 and amend as described in the claims section below.

Please amend paragraph [0001] as follows:

Technical Field

The present invention relates to an EL (electroluminescence) display device and an electronic device using the display device, and more specifically, relates to a technique for preventing deterioration of an EL element.

Please amend paragraph [0002] as follows:

Prior Art

In recent years, development of a display device using an EL element as a self-light emitting element that utilizes an EL phenomenon of an organic material (EL display device) is being progressed. The EL display device is a self-light emitting type, and thus, does not need a back light unlike a liquid crystal display device. Further, the EL display device has a wide viewing angle, and therefore, is promising as a display portion of a portable device used outdoors.

Please amend paragraph [0004] as follows:

### Summary

In one general aspect, an EL display device includes a substrate on which an EL element is formed, a cover member, a filler for adhering said substrate on which the EL element is formed to said cover member, a sealing member for covering a side surface of said filler, and a frame member adhered with said sealing member.

In another general aspect, an EL display device includes an active matrix substrate on which a TFT and an EL element electrically connected with the TFT are formed, a cover member, a filler for adhering said active matrix substrate to said cover member, a sealing member for covering a side surface of said filler, and a frame member adhered with said sealing member.

In another general aspect, an EL display device includes a substrate on which an EL element composed of an anode arranged in a stripe, a cathode arranged in a stripe so as to be perpendicular to said anode, and an EL layer formed between said anode and said cathode, a cover member, a filler for adhering said substrate on which the EL element is formed to said cover member, a sealing member for covering a side surface of said filler, and a frame member adhered with said sealing member.

Implementations of the EL display devices may include one or more the following features. For example, the EL display devices may include a drying agent in the filler. The drying agent may include barium oxide. The drying agent may have a granular shape with an average diameter of 100  $\mu\text{m}\phi$ , and a density of  $1 \times 10^2$  to  $1 \times 10^5$  atoms/cm<sup>3</sup>. The cover member may be provided with a light shielding film or color filter. An electronic device and/or a portable telephone may include the EL display devices in a display portion thereof.

An object of the present invention is to provide an EL display device with high reliability. Further, another object of the present invention is to provide an electronic device using such an EL display device with high reliability as its display portion.

### Description of the Drawings

Fig. 1A is a side view of an EL display device without a sealing structure.

Fig. 1B is a side view of the EL display device of Fig. 1B with a sealing structure.

Fig. 2A is a cross-sectional side view of the EL display device of Fig. 1B taken along section lines A-A'

Fig. 2B is a cross-sectional side view of the EL display device of Fig. 1B taken along section lines B-B'.

Fig. 3 is a cross-section side view of an EL display device.

Fig. 4 is a plan view of a bonding apparatus of a double vacuum system.

Fig. 5 is a cross-sectional side view of an EL display device in which a PVF film is used as a cover member.

Fig. 6 is a cross-sectional side view of a simple matrix EL display device having a cover member.

Fig. 7 is a cross-sectional side view of a simple matrix EL display device.

Fig. 8A is a perspective view of an EL display.

Fig. 8B is a perspective view of an EL display implemented in a video camera.

Fig. 8C is a perspective view of an EL display implemented as a head mounted display.

Fig. 8D is a perspective view of an EL display implemented in a DVD playback device.

Fig. 8E is a perspective view of an EL display implemented in a device with a camera and a display portion.

Fig. 8F is a perspective view of an EL display implemented in a portable computer.

Fig. 9A is a perspective view of a portable telephone in which the EL display has been incorporated.

Fig. 9B is a perspective view of a car audio system in which the EL display has been incorporated.

Please amend paragraph [0005] as follows:

### Detailed Description

A structure of the present invention is explained with reference to Fig. 1. Fig. 1A shows an EL display device of the present invention in a state that a sealing structure for sealing an EL element in a sealing space is not provided.

Please amend paragraph [0022] as follows:

Embodiment mode of the present invention is explained with reference to Fig. 3. Fig. 3 is a cross-sectional view of an EL display device of the present invention. Note that the basic structure is the same as Fig. 2A, and thus, the explanation is made as the need arises.

Please amend paragraph [0037] as follows:

Embodiments

Embodiment 1

In this embodiment, an example of using a PVF film as a cover member is shown in Fig. 5. In Fig. 5, reference numeral 501 indicates a light transmitting substrate (a plastic substrate in this embodiment), 502 indicates a pixel portion, 503 indicates a driver circuit, and the respective portions are formed of TFTs. Besides, an EL element 504 is formed in the pixel portion 502, and image display is performed.

Please amend paragraph [0040] as follows:

Embodiment 2

In this embodiment, an example of implementing the present invention in a simple matrix EL display device is shown in Fig. 6. In Fig. 6, reference numeral 601 indicates a plastic substrate, and reference numeral 602 indicates a cathode with a lamination structure of an aluminum film and a lithium fluoride film (the lithium fluoride film corresponds to the portion contacting an EL layer). In this embodiment, the cathode 602 is formed by an evaporation method. Note that, although not shown in Fig. 6, a plurality of cathodes is arranged in stripe in a direction perpendicular to the paper.

Please amend paragraph [0048] as follows:

Embodiment 3

In this embodiment, an example of implementing the present invention in a simple matrix EL display device is shown in Fig. 7. In Fig. 7, reference numeral 701 indicates a glass substrate, and reference numeral 702 indicates an anode made of a transparent conductive film. In this embodiment, a compound of indium oxide and tin oxide is formed by a sputtering method. Note that, although not shown in Fig. 7, a plurality of anodes is arranged in stripe in a direction perpendicular to the paper.

Please amend paragraph [0055] as follows:

Embodiment 4

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An EL display device formed by implementing the present invention is of a self light emitting type, and thus, it is excellent in visibility in the light in comparison with a liquid crystal display device, and also has a wide viewing angle. Therefore, the EL display device can be used as a display portion of various electronic devices. For example, the EL display device of the present invention may be used as a display portion of an EL display (a display incorporated with the EL display device in its casing) having a screen size of a 30 inch diagonal or larger (typically a 40 inch diagonal or larger) in order to watch TV broadcasting and the like with a large screen.

Please amend the paragraph [0070] as follow:

#### Effects of the Invention

The deterioration of the EL element portion of the EL display device can be effectively suppressed by implementing the present invention. Therefore, the EL display device with high reliability can be obtained. Further, such an EL display device with high reliability is used as the display portion of the electronic device, whereby the reliability of the electronic device can be enhanced.

#### In the claims:

Claims 1-10 have been amended as follows:

--1. An EL display device comprising a substrate on which an EL element is formed, a cover member, a filler for adhering said substrate on which the EL element is formed to said cover member, a sealing member for covering a side surface of said filler, and a frame member adhered with said sealing member.--

--2. An EL display device comprising an active matrix substrate on which a TFT and an EL element electrically connected with the TFT are formed, a cover member, a filler for adhering said active matrix substrate to said cover member, a sealing member for covering a side surface of said filler, and a frame member adhered with said sealing member.--

--3. An EL display device comprising a substrate on which an EL element composed of an anode arranged in a stripe, a cathode arranged in a stripe so as to be perpendicular to said

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anode, and an EL layer formed between said anode and said cathode, a cover member, a filler for adhering said substrate on which the EL element is formed to said cover member, a sealing member for covering a side surface of said filler, and a frame member adhered with said sealing member.--

--4. An EL display device as claimed in claim 1 wherein a drying agent is included in said filler.--

--5. An EL display device as claimed in claim 1 wherein said cover member is provided with a light shielding film or color filter.--

--6. An EL display device as claimed in claim 5 wherein a drying agent is included in said light shielding film or color filter.--

--7. An EL display device as claimed in claim 4 wherein said drying agent comprises barium oxide.--

--8. An EL display device as claimed in claim 4 wherein said drying agent has a granular shape with an average diameter of  $100\text{ }\mu\text{m}\varnothing$ , and is included with a density of  $1 \times 10^2$  to  $1 \times 10^5$  atoms/cm<sup>3</sup>.--

--9. An electronic device including the EL display device according to claim 1 in a display portion thereof.--

--10. A portable telephone including the EL display device according to claim 1 in a display portion thereof.--

Claims 11-30 have been added as follows:

--11. An EL display device as claimed in claim 2 wherein a drying agent is included in said filler.--

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--12. An EL display device as claimed in claim 3 wherein a drying agent is included in said filler.--

--13. An EL display device as claimed in claim 2 wherein said cover member is provided with a light shielding film or color filter.--

--14. An EL display device as claimed in claim 3 wherein said cover member is provided with a light shielding film or color filter.--

--15. An EL display device as claimed in claim 13 wherein a drying agent is included in said light shielding film or color filter.--

--16. An EL display device as claimed in claim 14 wherein a drying agent is included in said light shielding film or color filter.--

--17. An EL display device as claimed in claim 6 wherein said drying agent comprises barium oxide.--

--18. An EL display device as claimed in claim 11 wherein said drying agent comprises barium oxide.--

--19. An EL display device as claimed in claim 12 wherein said drying agent comprises barium oxide.--

--20. An EL display device as claimed in claim 15 wherein said drying agent comprises barium oxide.--

--21. An EL display device as claimed in claim 16 wherein said drying agent comprises barium oxide.--

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--22. An EL display device as claimed in claim 6 wherein said drying agent has a granular shape with an average diameter of  $100\text{ }\mu\text{m}\varnothing$ , and is included with a density of  $1 \times 10^2$  to  $1 \times 10^5$  atoms/cm<sup>3</sup>.--

--23. An EL display device as claimed in claim 11 wherein said drying agent has a granular shape with an average diameter of  $100\text{ }\mu\text{m}\varnothing$ , and is included with a density of  $1 \times 10^2$  to  $1 \times 10^5$  atoms/cm<sup>3</sup>.--

--24. An EL display device as claimed in claim 12 wherein said drying agent has a granular shape with an average diameter of  $100\text{ }\mu\text{m}\varnothing$ , and is included with a density of  $1 \times 10^2$  to  $1 \times 10^5$  atoms/cm<sup>3</sup>.--

--25. An EL display device as claimed in claim 15 wherein said drying agent has a granular shape with an average diameter of  $100\text{ }\mu\text{m}\varnothing$ , and is included with a density of  $1 \times 10^2$  to  $1 \times 10^5$  atoms/cm<sup>3</sup>.--

--26. An EL display device as claimed in claim 16 wherein said drying agent has a granular shape with an average diameter of  $100\text{ }\mu\text{m}\varnothing$ , and is included with a density of  $1 \times 10^2$  to  $1 \times 10^5$  atoms/cm<sup>3</sup>.--

--27. An electronic device including the EL display device according to claim 2 in a display portion thereof.--

--28. An electronic device including the EL display device according to claim 3 in a display portion thereof.--

--29. A portable telephone including the EL display device according to claim 2 in a display portion thereof.--

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--30. A portable telephone including the EL display device according to claim 3 in a display portion thereof.--

In the abstract

The abstract has been amended as follows:

A cover member is adhered onto a substrate on which an EL element is formed with a filler as an adhesive. Further, a sealing member is provided so as to cover a side surface (an exposing surface) of the filler, and a frame member is adhered using the sealing member. With this structure, the EL element is completely sealed by the filler, and shut from moisture and the like from the outside. Thus, deterioration of an EL layer due to oxidization can be prevented.

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REMARKS

Claims 1-30 are pending in this application with claims 1-3 being independent. Claims 1-10 have been amended and claims 11-30 have been added. Support for claims 11-30 is found in claims 1-10 as filed. The specification and the abstract have been amended to conform to U.S. practice. No new matter is added.

Attached is a marked-up version of the changes being made by the current amendment.

Applicant asks that all claims be examined. Please apply any charges or credits to Deposit Account No. 06-1050.

Respectfully submitted,

Date: October 30, 2001

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**Version with markings to show changes made**

In the specification:

The text at page 1, lines 1-4 has been canceled.

The claims extending between page 1, line 5 and page 3, line 10 have been moved and amended as described below.

Paragraph [0001] has been amended as follows:

**[[ Technical Field [to which the Invention belongs]]**

The present invention relates to an EL (electroluminescence) display device and an electronic device using the display device, and more specifically, relates to a technique for preventing deterioration of an EL element.

Please amend the specification beginning at page 3, line 18 and continuing forward as follows:

Paragraph [0002] has been amended as follows:

**[[Prior Art]]**

In recent years, development of a display device using an EL element as a self-light emitting element that utilizes an EL phenomenon of an organic material (EL display device) is being progressed. The EL display device is a self-light emitting type, and thus, does not need a back light unlike a liquid crystal display device. Further, the EL display device has a wide viewing angle, and therefore, is promising as a display portion of a portable device used outdoors.

Paragraph [0004] has been amended as follows:

**[[Problems to be solved by the Invention]] Summary**

In one general aspect, an EL display device includes a substrate on which an EL element is formed, a cover member, a filler for adhering said substrate on which the EL element is formed to said cover member, a sealing member for covering a side surface of said filler, and a frame member adhered with said sealing member.

Fig. 4 is a plan view of a bonding apparatus of a double vacuum system.

Fig. 5 is a cross-sectional side view of an EL display device in which a PVF film is used as a cover member.

Fig. 6 is a cross-sectional side view of a simple matrix EL display device having a cover member.

Fig. 7 is a cross-sectional side view of a simple matrix EL display device.

Fig. 8A is a perspective view of an EL display.

Fig. 8B is a perspective view of an EL display implemented in a video camera.

Fig. 8C is a perspective view of an EL display implemented as a head mounted display.

Fig. 8D is a perspective view of an EL display implemented in a DVD playback device.

Fig. 8E is a perspective view of an EL display implemented in a device with a camera and a display portion.

Fig. 8F is a perspective view of an EL display implemented in a portable computer.

Fig. 9A is a perspective view of a portable telephone in which the EL display has been incorporated.

Fig. 9B is a perspective view of a car audio system in which the EL display has been incorporated.

Paragraph [0005] has been amended as follows:

**[[Means to solve the Problem]]** Detailed Description

A structure of the present invention is explained with reference to Fig. 1. Fig. 1A shows an EL display device of the present invention in a state that a sealing structure for sealing an EL element in a sealing space is not provided.

Paragraph [0022] has been amended as follows:

**[[Embodiment Mode of the Invention]]**

Embodiment mode of the present invention is explained with reference to Fig. 3. Fig. 3 is a cross-sectional view of an EL display device of the present invention. Note that the basic structure is the same as Fig. 2A, and thus, the explanation is made as the need arises.

Paragraph [0037] has been amended as follows:

**[[Embodiments]]**

**[[Embodiment 1]]**

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Paragraph [0040] has been amended as follows:

In this embodiment, an example of implementing the present invention in a simple matrix EL display device is shown in Fig. 6. In Fig. 6, reference numeral 601 indicates a plastic substrate, and reference numeral 602 indicates a cathode with a lamination structure of an aluminum film and a lithium fluoride film (the lithium fluoride film corresponds to the portion contacting an EL layer). In this embodiment, the cathode 602 is formed by an evaporation method. Note that, although not shown in Fig. 6, a plurality of cathodes is **[are]** arranged in stripe in a direction perpendicular to the paper.

[[Embodiment 3]]

In this embodiment, an example of implementing the present invention in a simple matrix EL display device is shown in Fig. 7. In Fig. 7, reference numeral 701 indicates a glass substrate, and reference numeral 702 indicates an anode made of a transparent conductive film. In this embodiment, a compound of indium oxide and tin oxide is formed by a sputtering method. Note that, although not shown in Fig. 7, a plurality of anodes is **[are]** arranged in stripe in a direction perpendicular to the paper.

[[Embodiment 4]]

An EL display device formed by implementing the present invention is of a self light emitting type, and thus, it is excellent in visibility in the light in comparison with a liquid crystal display device, and also has a wide viewing angle. Therefore, the EL display device can be used as a display portion of various electronic devices. For example, the EL display device of the present invention may be used as a display portion of an EL display (a display incorporated with

the EL display device in its casing) having a screen size of a 30 inch diagonal or larger (typically a 40 inch diagonal or larger) in order to watch TV broadcasting and the like with a large screen.

Paragraph [0070] has been amended as follows:

**[[Effects of the Invention]]**

The deterioration of the EL element portion of the EL display device can be effectively suppressed by implementing the present invention. Therefore, the EL display device with high reliability can be obtained. Further, such an EL display device with high reliability is used as the display portion of the electronic device, whereby the reliability of the electronic device can be enhanced.

**[[Brief Description of the Drawings]]**

**[Figs. 1]       Diagrams showing top surface structures of an EL display device.**

**[Figs. 2]       Diagrams showing cross sectional structures of the EL display device.**

**[Fig. 3]       A diagram showing a cross sectional structure of an EL display device.**

**[Fig. 4]       A diagram showing a bonding apparatus of a double vacuum system.**

**[Fig. 5]       A diagram showing a cross sectional structure of an EL display device.**

**[Fig. 6]       A diagram showing a cross sectional structure of an EL display device.**

**[Fig. 7]       A diagram showing a cross sectional structure of an EL display device.**

**[Figs. 8]       Diagrams showing specific examples of electronic devices.**

**[Figs. 9]       Diagram showing specific examples of electronic devices.]**

**In the claims:**

Claims 1-10 have been amended as follows:

**[[Claim 1]]**

**1.**     An EL display device **[characterized by]** comprising a substrate on which an EL element is formed, a cover member, a filler for adhering said substrate on which the EL element

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is formed to said cover member, a sealing member for covering a side surface of said filler, and a frame member adhered with said sealing member.

**[[Claim 2]]**

2. An EL display device **[characterized by]** comprising an active matrix substrate on which a TFT and an EL element electrically connected with the TFT are formed, a cover member, a filler for adhering said active matrix substrate to said cover member, a sealing member for covering a side surface of said filler, and a frame member adhered with said sealing member.

**[[Claim 3]]**

3. An EL display device **[characterized by]** comprising a substrate on which an EL element composed of an anode arranged in a stripe, a cathode arranged in a stripe so as to be perpendicular to said anode, and an EL layer formed between said anode and said cathode, **[is formed,]** a cover member, a filler for adhering said substrate on which the EL element is formed □ said cover member, a sealing member for covering a side surface of said filler, and a frame member adhered with said sealing member.

**[[Claim 4]]**

4. An EL display device as claimed in claim 1 wherein **[any one of claims 1 to 3, characterized in that]** a drying agent is included in said filler.

**[[Claim 5]]**

5. An EL display device as claimed in claim 1 wherein **[any one of claims 1 to 3, characterized in that]** said cover member is provided with a light shielding film or color filter.

**[[Claim 6]]**

6. An EL display device as claimed in claim 5 wherein **[, characterized in that]** a drying agent is included in said light shielding film or color filter.

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**[[Claim 7]]**

7. An EL display device as claimed in claim 4 wherein **[or claim 6, characterized in that]** said drying agent **[is]** comprises barium oxide.

**[[Claim 8]]**

8. An EL display device as claimed in claim 4 wherein **[or claim 6, characterized in that]** said drying agent has a granular shape with an average diameter of 100  $\mu\text{m}\varnothing$ , and is included with a density of  $1 \times 10^2$  to  $1 \times 10^5$  atoms/cm<sup>3</sup>.

**[[Claim 9]]**

9. An electronic device including **[characterized by using]** the EL display device according to claim 1 **[any one of claims 1 to 8]** in a display portion thereof.

**[[Claim 10]]**

10. A portable telephone including **[characterized by using]** the EL display device according to claim 1 **[any one of claims 1 to 8]** in a display portion thereof.

In the abstract

The abstract has been amended as follows:

**[[Document Name] Abstract**

**[[Summary]**

**[Problem] To provide an EL display device with high reliability**

**[Solving Means]**

A cover member [107] is adhered onto a substrate [101] on which an EL element is formed with a filler [208] as an adhesive. Further, a sealing member [209] is provided so as to cover a side surface (an exposing surface) of the filler [208], and a frame member [108] is adhered using the sealing member [209]. With this structure, the EL element is completely sealed by the filler [208], and shut from moisture and the like from the outside. Thus, deterioration of an EL layer due to oxidization can be prevented.

**[[Selected Drawing] Fig. 2**

**[DESCRIPTION OF A MARK]**

**[Fig. 2]**

102

A pixel portion

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103 A driver circuit  
B indicates "a light radiation direction"  
[Fig. 3]  
302 A pixel portion  
303 A driver circuit  
Y indicates "a light radiation direction"  
[Fig. 5]  
502 A pixel portion  
503 A driver circuit  
B indicates "a light radiation direction"  
[Fig. 6]  
Y indicates "a light radiation direction"  
[Fig. 7]  
B indicates "a light radiation direction"  
[Fig. 8]  
(A) 2001 A casing  
2002 A support stand  
2003 A display portion  
(B) 2101 A main body  
2102 A display portion  
2103 A sound input portion  
2104 Operation switches  
2105 A battery  
2106 An image receiving portion  
(C) 2201 A main body  
2202 Signal cables  
2203 A head fixing band  
2204 A display portion  
2205 An optical system  
2206 An EL display device  
(D) 2301 A main body  
2302 A recording medium  
2303 Operation switches  
2304 A display portion (a)  
2305 A display portion (b)  
(E) 2401 A main body  
2402 A camera portion  
2403 An image receiving portion  
2404 An operation switch  
2405 A display portion  
(F) 2501 A main body  
2502 A casing  
2503 A display portion  
2504 A keyboard

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**[Fig.9]**

**(A)**

**2602**

**2603**

**2604**

**2605**

**2606**

**(B)**

**2702**

**2703**

**2704**

**2601 A main body**

**A sound input portion**

**A sound input portion**

**A display portion**

**Operation switches**

**An antenna**

**2701 A main body**

**A display portion**

**Operation switches**

**Operation switches]**

FIG. 9